WHAT IS CLAIMED IS:

1. A method of source normalization training for HMM modeling of speech comprising the steps of:

(a) providing an initial model;

(b) on said initial model or following new models performing the following steps to get a new model:

b_1) estimation of intermediate quantities;

b_2) performing re-estimation to determine initial state probability, transition probability, mixture component probability and environment probability;

b_3) deriving mean vector and bias vector;

b_4) solving jointly for mean vector and bias vector using linear equations and determining variances and transformation; and

b_5) replacing old model parameters for the calculated ones; and

c) determining after a new model is formed if it differs significantly from the previous model and if so repeating steps b_1 - b_5.

2. The method of Claim 1 wherein in step b_1 estimation intermediate quantities is determined by $\alpha_t(j,e) \triangleq p(o_1^t, \theta_t = j, \varphi = e | \bar{\lambda})$,

$\beta_t(j,e) \triangleq p(o_{t+1}^T | \theta_t = j, \varphi = e, \bar{\lambda})$, and $\gamma_t(j,k,e) \triangleq p(\theta_t = j, \xi_t = k, \varphi = e | O, \bar{\lambda})$.

3. The method of Claim 2 wherein step b_2 the initial state probability is determined by $u_i = \frac{1}{R}\sum_{r=1}^{R}\frac{\sum_{e\in\Omega_e}\alpha_1^r(i,e)\beta_1^r(i,e)}{\sum_{i\in\Omega_s}\sum_{e\in\Omega_e}\alpha_1^r(i,e)\beta_1^r(i,e)}$, transition probability is determined by

$$a_{ij} = \frac{\bar{a}_{ij}\sum_{r=1}^{R}\frac{1}{p(O^r|\bar{\lambda})}\sum_{e\in\Omega_e}\sum_{t=1}^{T^r}\alpha_t^r(i,e)b_{j,e}(o_{t+1}^r)\beta_{t+1}^r(j,e)}{\sum_{r=1}^{R}\frac{1}{p(O^r|\bar{\lambda})}\sum_{e\in\Omega_e}\sum_{t=1}^{T^r}\alpha_t^r(i,e)\beta_t^r(i,e)},$$

mixture component probability is determined by

$$c_{jk} = \frac{\sum_{r=1}^{R}\sum_{e\in\Omega_e}\sum_{t=1}^{T^r}\gamma_t^r(j,k,e)}{\sum_{r=1}^{R}\frac{1}{p(O^r|\bar{\lambda})}\sum_{e\in\Omega_e}\sum_{t=1}^{T^r}\alpha_t^r(j,e)\beta_t^r(j,e)},$$

and environment probability is determined by $l_e = \frac{1}{R}\sum_{r=1}^{R}\frac{\sum_{j\in\Omega_s}\alpha_T^r(j,e)}{\sum_{e\in\Omega_e}\sum_{j\in\Omega_s}\alpha_T^r(j,e)}$.

4. The method of Claim 2 wherein step b_3 deriving mean vector and bias vector is determined by $\rho(j,k,e) \triangleq \sum_{r=1}^{R}\sum_{t=1}^{T^r}\gamma_t^r(j,k,e)o_t^r$; $g(j,k,e) \triangleq \sum_{r=1}^{R}\sum_{t=1}^{T^r}\gamma_t^r(j,k,e)$,

$$G_{ke} = \sum_{j\in\Omega_s} g(j,k,e)\Sigma_{jk}^{-1}, \qquad E_{jke} = g(j,k,e)W_{je}'\Sigma_{jk}^{-1}, \qquad F_{jk} = \sum_{e\in\Omega_e} E_{jke}W_{je},$$

$a_{jk} = \sum_{e\in\Omega_e} W_{je}'\Sigma_{jk}^{-1}\rho(j,k,e)$, and $c_{ke} = \sum_{j\in\Omega_s}\Sigma_{jk}^{-1}\rho(j,k,e)$.

5. The method of Claim 2 wherein step b_4 equations $\sum_{e\in\Omega_e} E_{jke}b_{ke} + F_{jk}\,\mu_{jk} = a_{jk} \quad \forall j \in \Omega_s$ and $G_{ke}b_{ke} + \sum_{j\in\Omega_s} H_{jke}\,\mu_{jk} = c_{ke} \quad \forall e \in \Omega_e$ are used for solving jointly and equation $\Sigma_{jk} = \frac{\sum_{e\in\Omega_e}\sum_{r=1}^{R}\sum_{t=1}^{T^r}\gamma_t^r(j,k,e)\delta_t^r(j,k,e)\delta_t^r(j,e,k)'}{\sum_{e\in\Omega_e} g(j,k,e)}$

is used to determine variance and equations $Z_{je}^{(m)} = W_{je}^{(m)} R_{je}(m)$,

$$Z_{je}^{(m,n)} \triangleq \sum_{k \in \Omega_m} \Sigma_{jk}^{-1(m,m)} \mu_{jk}^{(n)} \sum_{r=1}^{R} \sum_{t=1}^{T^r} \gamma_t^r (j,k,e)(o_t^r - b_{ke})^{(m)},$$ and

$$R_{je}^{(p,n)}(m) \triangleq \sum_{k \in \Omega_m} \Sigma_{jk}^{-1(m,m)} \mu_{jk}^{(p)} \mu_{jk}^{(n)} \sum_{r=1}^{R} \sum_{t=1}^{T^r} \gamma_t^r (j,k,e).$$ are used to determine transformation.

SUB Q2

6. An improved speech recognition system comprising:

a speech recognizer; and

a source normalization model derived by application of an estimation maximization algorithm.

ADD Q3

add B1

add E1